CONCISE STATEMENT OF RELEVANCE

for

JP 07-142407-A1

This invention is a plasma generating device that deposits a thin film having a uniform thickness and quality. The plasma generating device generates a uniform plasma by setting a ratio of opposing areas of a ground electrode and a high-frequency electrode on the periphery of the plasma space that is equal to that in a central part of the plasma space.

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-142407
(43)Date of publication of application : 02.06.1995

(51)Int.CI. H01L 21/205
C23C 16/50
C23C 16/52

(21)Application number : 05-307169
(22)Date of filing : 12.11.1993

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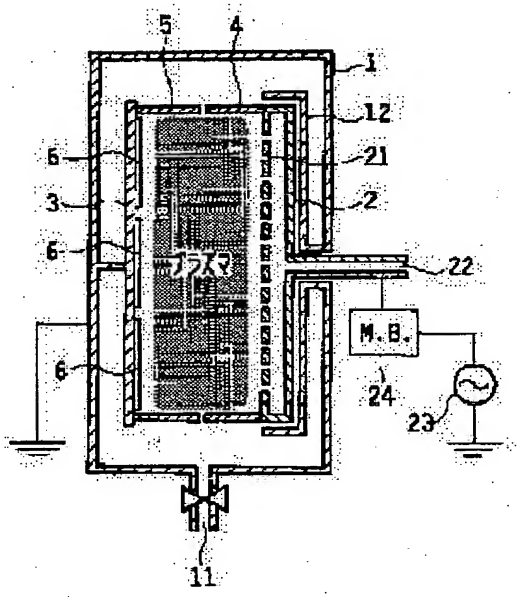
(54) PLASMA GENERATOR

(57)Abstract:
PURPOSE: To provide a plasma generator employed in a system for depositing a thin film having uniform thickness and quality in which the properties of plasma are made uniform, by setting the ratio of electrically opposing areas of an earth electrode and a high frequency electrode on the periphery of a plasma space equal to that in the central part.
CONSTITUTION: A high frequency electrode 2 for feeding high frequency power to an introduced gas and a substrate tray 3 at the earth potential are disposed oppositely each other in a vacuum vessel 1 and then plasma is generated between them. Auxiliary electrodes 4, 5 having the same potentials as the high frequency electrode and the substrate tray 3, respectively, are disposed closely thereto while surrounding a plasma space formed between the high frequency electrode 2 and the substrate tray 3. The ratio of areas of the auxiliary electrodes 4, 5 opposing the plasma space is set to a predetermined value.



LEGAL STATUS

[Date of request for examination] 01.02.2000
[Date of sending the examiner's decision of rejection] 05.03.2002
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] In the plasma generator which carries out opposite arrangement of the RF electrode and ground electrode which supply high-frequency power to introductory gas, and is made to generate the plasma between two electrodes in a vacuum housing The perimeter of the plasma space formed between the above-mentioned RF electrode and a ground electrode is covered. The plasma generator characterized by making the ratio of area which prepares this electrode and the 1st auxiliary electrode of this potential in the side near an RF electrode, prepares this electrode and the 2nd auxiliary electrode of this potential in the side near a ground electrode, respectively, and turns to the plasma space of these 1st auxiliary electrodes and the 2nd auxiliary electrode with a predetermined value.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the plasma distribution control for performing especially homogeneity membrane formation about the plasma generator used for plasma-CVD equipment etc.
[0002]
[Description of the Prior Art] An example of the conventional plasma-CVD equipment which installed the plasma generator inside is shown in drawing 7 . In drawing, a vacuum housing 1 has the flueing opening 11, it is exhausted by the vacuum pump of ****, and the interior is maintained at the vacuum. In the above-mentioned vacuum housing 1, the substrate tray 3 and RF electrode 2 holding a substrate 6 of ground potential counter, and are arranged. Above-mentioned RF electrode 2 is a flat bottle object, many gas inlets 21 are formed in a substrate 6 and the front face which counters, and the gas installation tubing 22 is connected to the rear face. Membrane formation gas is introduced in a vacuum housing 1 through a gas inlet 21 from the gas installation tubing 22.
[0003] The introduced membrane formation gas will be from RF generator 23 in the plasma state with the power supplied through a matching box 24 and RF electrode 2, causes a chemical reaction on plasma space or the front face of a substrate 6, deposits it on a substrate 6, and forms a thin film.
[0004] The above-mentioned conventional plasma-CVD equipment is with a center section and the periphery of the substrate tray 3, and had the problem that the thickness of the thin film formed and membraneous quality were uneven, and a uniform large membrane formation area could not be taken for this reason. It is thought that one of the cause of this is for the properties of the plasma of a center section and the periphery of plasma space to differ, and some approaches for solving this are proposed.
[0005] For example, in the Provisional-Publication-No. 63-No. 186419 official report, the side face of an RF electrode is surrounded with the shielding frame made into a substrate holder and this potential, the plasma is shut up between electrode pairs, and it is going to cancel the ununiformity of the plasma (the 1st conventional example). On the other hand, in the effective 64-No. 1958 official report, a discharge electrode plate is divided into plurality and adjusting the density distribution of the plasma is examined by controlling separately the high-frequency power introduced into each discharge electrode plate (the 2nd conventional example).
[0006]
[Problem(s) to be Solved by the Invention] However, according to an artificer's etc. experiment, equalization of the plasma is not yet enough by the plasma generator of the 1st conventional example. Moreover, it is still difficult not to equalize the property of the other plasma but to form thickness and the uniform thin film of membraneous quality in the 2nd conventional example, although it is effective in control of plasma density distribution.
[0007] According to the experiment and simulation which the artificer etc. performed, the cause of the plasma ununiformity in equipment is conventionally for the opposed face product ratios seen electrically [an RF electrode and a ground electrode (substrate tray 3)] by the center section and periphery of plasma space to differ. That is, in the conventional plasma-CVD equipment shown in drawing 7 , in the center section of plasma space, since the wall of a vacuum housing 1 functions as a ground electrode by the periphery to the opposed face product ratio of RF electrode 2 and the ground electrode 3 being about 1:1 in addition to the substrate tray 3, the opposed face product ratio seen electrically becomes 1:a (a> 1). Thus, by the periphery, a substantial area of a ground electrode is large and it is thought that the difference in this electrode surface product causes a plasma ununiformity.
[0008] Then, when it is made for the opposed face product ratio seen electrically [the RF electrode in the periphery of plasma space and a ground electrode] to become equal to the opposed face product ratio in a center section, it equalizes the property of the plasma of a center section and a periphery by this and applies the purpose of this invention to membrane formation equipment, it is to offer the plasma generator which can form thickness and the uniform thin film of membraneous quality.
[0009]
[Means for Solving the Problem] In the plasma generator which carries out opposite arrangement of RF electrode 2 and the ground electrode 3 which supply high-frequency power to introductory gas, and is made to generate the plasma between two electrodes 2 and 3 in a vacuum housing 1 when the configuration of this invention is explained The perimeter of the plasma space formed between above-mentioned RF electrode 2 and the ground electrode 3 is covered. The 2nd auxiliary electrode 5 which made the 1st auxiliary electrode 4 made into this electrode 2 and this potential at the side near RF electrode 2 this electrode 3 and this potential at the side near the ground electrode 3 is formed, respectively, and the ratio of area suitable for the plasma space of these 1st auxiliary electrodes 4 and the 2nd auxiliary electrode 5 is made with a predetermined value.
[0010]

[Function] In not preparing an auxiliary electrode, by the periphery of plasma space, the opposed face product ratio which RF electrode 2 and the ground electrode 3 looked at electrically is set to 1:a (a> 1) like previous statement. Then, the perimeter of BURAZUMA space is covered, the 1st auxiliary electrode 4 made into RF electrode 2 and this potential and the 2nd auxiliary electrode 5 made into the ground electrode 3 and this potential are formed, if the ratio of area which these electrodes 4 and 5 face plasma space is made into a predetermined value, the opposed face product ratio of RF electrode 2 and the ground electrode 3 in the periphery of plasma space will be amended, and the ratio seen electrically will be set to 1:1. Consequently, the property of the plasma of a periphery becomes the same as a center section, and the membraneous quality of the thin film by which laminating formation is carried out, and thickness become the substrate formed on the ground electrode 2 with homogeneity by the center section and the periphery. Moreover, if the surface ratio of both the above-mentioned auxiliary electrodes 4 and 5 is changed suitably, since the opposed face product ratio which RF electrode 2 in a periphery and the ground electrode 3 looked at electrically will be changed into a desired value, the property of the plasma of a periphery is controlled and it becomes possible to the membraneous quality of the thin film of a center section, and thickness to set the membraneous quality of a periphery, and thickness as a predetermined thing.

[0011]

[Example 1] An example of plasma-CVD equipment which used the plasma generator of this invention for drawing 1 is shown. In drawing, it has the flueing opening 11 on a base, internal gas is discharged by the vacuum pump of ****, and the vacuum housing 1 is held at the vacuum. In the above-mentioned vacuum housing 1, it is made to hold to the wall, and the substrate tray 3 is arranged and two or more substrates 6 are held at the core and periphery on this substrate tray 3. In addition, this substrate tray 3 functions as a ground electrode.

[0012] RF electrode 2 is arranged on the opposite location of the above-mentioned substrate tray 3. Many gas inlets 21 are formed in the front face which counters the above-mentioned substrate tray 3 of this RF electrode 2, and membrane formation gas is introduced in a vacuum housing 1 through the gas installation tubing 22 connected to the tooth back. Above-mentioned RF electrode 2 is connected to RF generator 23 installed outside through the matching box 24.

[0013] The space between RF electrode 2 and the substrate tray 3 is covered, the tubed auxiliary electrodes 4 and 5 of a pair are arranged, and while a tip makes a small gap and counters, the end face is carrying out the contact flow of these auxiliary electrodes 4 and 5 at the periphery section of RF electrode 2 and the substrate tray 3, respectively. Perimeter area of these auxiliary electrodes 4 and 5 is made the same.

[0014] The ground covering 12 which follows a vacuum housing 1 sets a predetermined gap behind above-mentioned RF electrode 2, and is prepared in it, and it has prevented that discharge arises between an electrode 2 and the wall of a vacuum housing 1.

[0015] The membrane formation gas introduced in the vacuum housing 1 will be from above-mentioned RF generator 23 in the plasma state with the power supplied through a matching box 24 and RF electrode 2. And a chemical reaction is caused on the front face of the plasma space formed between the above-mentioned substrate tray 3 and RF electrode 2, or the above-mentioned substrate 6, it deposits on a substrate 6, and a thin film is formed.

[0016] At this time, as the auxiliary electrode 4 which carries out a contact flow is shown in RF electrode 2 by being prepared in that perimeter at drawing 2 , it is maintained by the same RF as RF electrode 2 by the potential in which positive/negative carries out alternation, so that plasma space may be covered, and on the other hand, the auxiliary electrode 5 which carries out a contact flow at the substrate tray 3 is maintained by fixed ground potential.

[0017] Since the area which attends the plasma space of auxiliary electrodes 4 and 5 set the same, i.e., surface ratio, to 1:1, a thin film with an opposed face product ratio homogeneous also to the substrate 6 with which either a center section or a periphery became homogeneity, and the property of the plasma prepared it in any of a center section and the periphery of the substrate tray 3 by being substantially set to 1:1 with RF electrode 2 in the periphery of the substrate tray 3 seen electrically is formed.

[0018] If this effectiveness is checked by the ion current, in drawing 3 , the ion current will become large as it separates from the core of the substrate tray 3 to the area S1 of the auxiliary electrode 4 of RF (RF) potential so that the area S2 of the auxiliary electrode 5 of ground potential is large. The ion current becomes small as it separates from the core of the substrate tray 3 to the above-mentioned area S1 on the contrary so that area S2 is small. After all, it is equal in the above-mentioned area S1 and S2, namely, when surface ratio S1/S2 is made into 1/1, it is known that the ion current will become almost uniform in the large range on the substrate tray 3, and the plasma will become homogeneity by the center section and the periphery.

[0019]

[Example 2] By the way, as for the ion current, the result of the above-mentioned example 1 does not become the same as that of a core as for 1/1 about surface ratio S1/S2 in the corner section, although materialized in the part which is separated from the corner section of the rectangle-like substrate tray 3. Then, as shown in drawing 4 , the surface ratio S1/S2 of an auxiliary electrode 4 and an auxiliary electrode 5 is continuously changed from the center section of each side to the corner section. Thereby, the property of the plasma is made to homogeneity all over the substrate tray containing the corner section.

[0020]

[Example 3] Although the auxiliary electrode 5 which this carries out a contact flow and serves as ground potential at it was formed in the periphery edge of the substrate tray 3 in each above-mentioned example, as it replaces with this and is shown in drawing 5 , the wrap ground covering 12 is made to extend the back of RF electrode 2 with about three substrate tray from a way outside RF electrode 2, and it is good also as an auxiliary electrode 5. The area of the substantial auxiliary electrode 5 in this case turns into area of the part which exposes from behind an auxiliary electrode 2 and attends plasma space directly.

[0021]

[Example 4] The property of the plasma of substrate tray 3 periphery changes with other factors, such as a pressure in a vacuum housing 1, and temperature. Then, as shown in drawing 6 , it makes that an attitude is possible by the motor 71 of an attachment of an auxiliary electrode 4, and modification of the surface ratio S1/S2 of auxiliary electrodes 4 and 5 is enabled. That is, if an auxiliary electrode 4 is made to march out, while the area S1 which attends plasma space will become large, the area S2 which attends the plasma space of an auxiliary electrode 5 becomes small, and surface ratio S1/S2 becomes large. It is this reverse when ** ON of the auxiliary electrode 4 is carried out. The forward reverse drive of the above-mentioned motor 71 is carried out with the feedback control vessel 7. The plasma monitors 72 and 73 are formed in this feedback control machine 7 at the center section and periphery of plasma space, respectively, and the plasma of a center section and a periphery can always be maintained at homogeneity by making an auxiliary electrode 4 move suitably through the above-mentioned motor 71 according to the signal from these plasma monitors 72 and 73.

[0022] In addition, if this invention is vacuum devices which use plasma, such as not only plasma-CVD equipment but a sputtering system, an etching system, etc., it is applicable to all. Moreover, it is applicable to both anode coupling and cathode coupling.

[0023]

[Effect of the Invention] As mentioned above, the plasma generator of this invention can be applied to for example, plasma-CVD equipment, can cancel the ununiformity of the plasma in a center section and a periphery, and can form thickness and the uniform thin film of membraneous quality in a larger area.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the whole plasma-CVD equipment outline sectional view in the example 1 of this invention.
[Drawing 2] It is the conceptual diagram showing electrode disposition.
[Drawing 3] It is drawing showing ion current distribution of plasma space.
[Drawing 4] It is the outline perspective view showing the electrode disposition in the example 2 of this invention.
[Drawing 5] It is the whole plasma-CVD equipment outline sectional view in the example 3 of this invention.
[Drawing 6] It is the whole plasma-CVD equipment outline sectional view in the example 4 of this invention.
[Drawing 7] It is the conventional whole plasma-CVD equipment outline sectional view.
[Description of Notations]
1 Vacuum Housing
11 Flueing Opening
12 Ground Covering
2 RF Electrode
22 Gas Installation Tubing
23 RF Generator
3 Substrate Tray (Ground Electrode)
4 1st Auxiliary Electrode
5 2nd Auxiliary Electrode
6 Substrate

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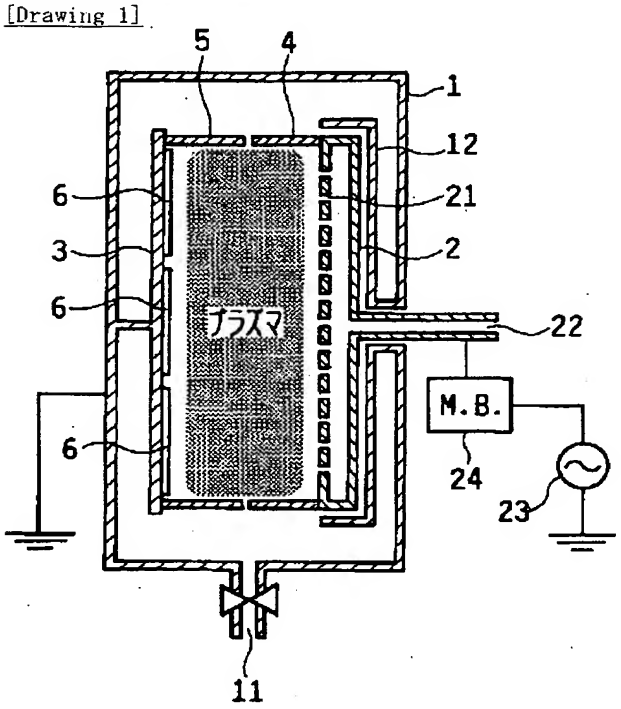
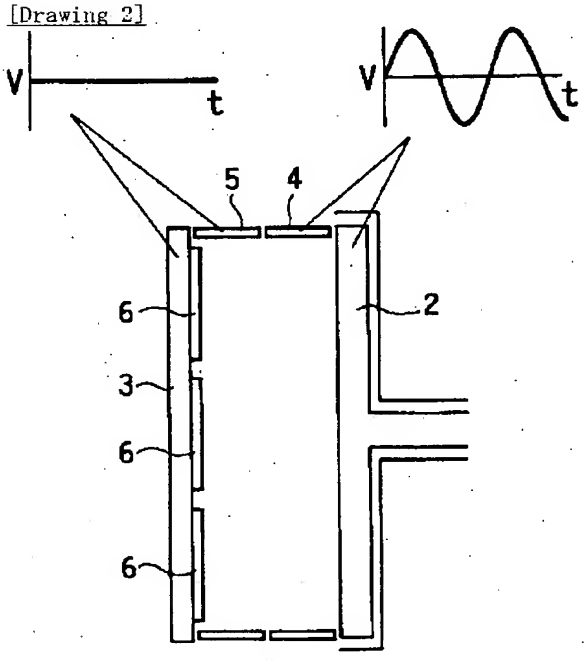
DRAWINGS

[Drawing 1]



[Drawing 2]



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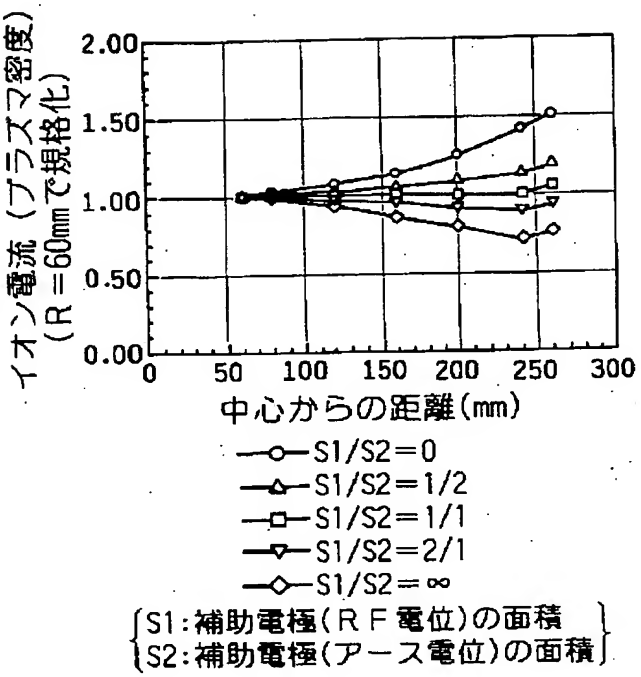
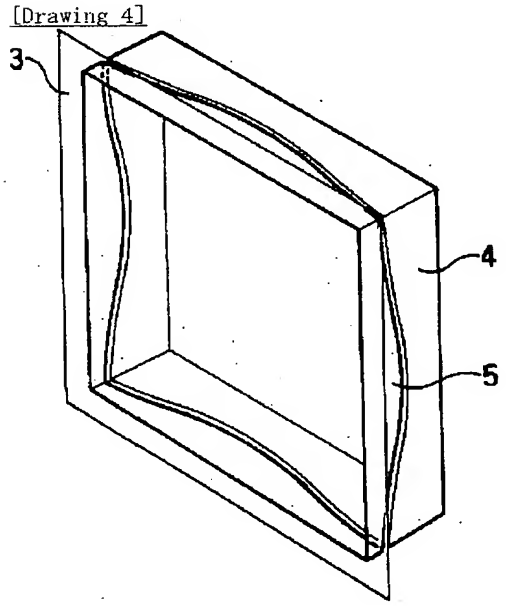


プラズマ空間のイオン電流分布

[Drawing 4]



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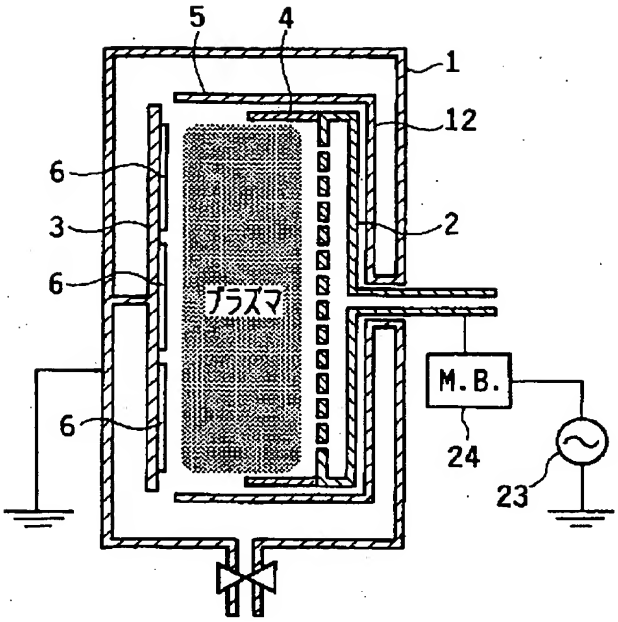
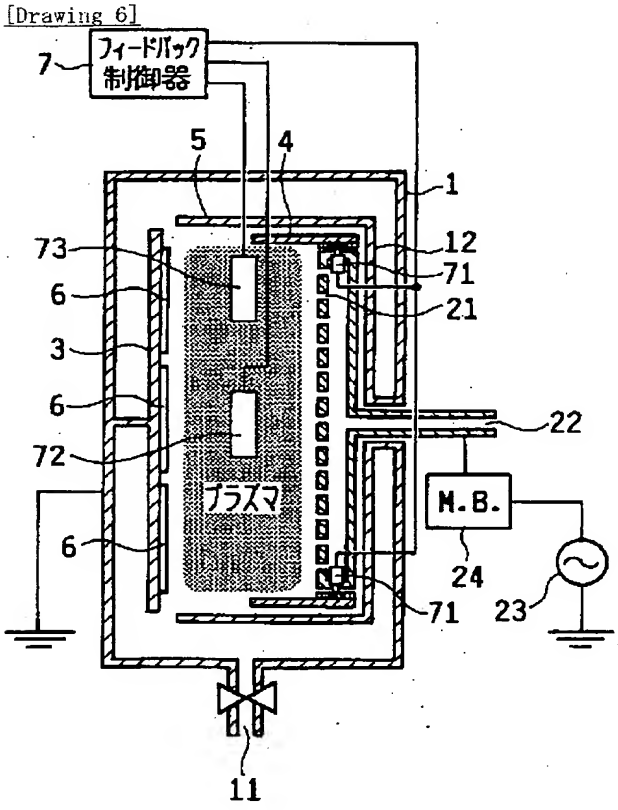
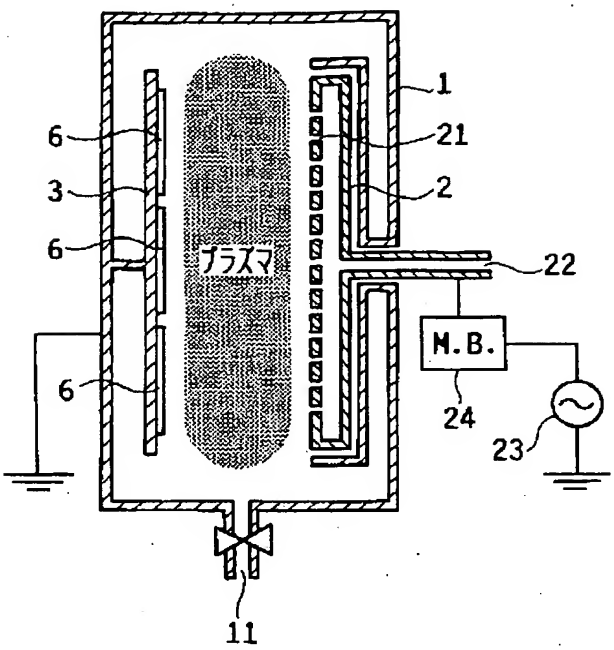


[Drawing 6]



[Drawing 7]



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